

## Claims

- 1 A composite lining for a pipe comprising:  
  
a structural layer for providing structural integrity; and  
  
a containment layer for providing fluid impermeability;  
  
wherein, the structural layer comprises at least one strip of lining material arranged to form a substantially continuous lining within said pipe.
- 2 A composite lining as claimed in claim 1 wherein the containment layer comprises at least one section of lining material arranged to form a substantially continuous impermeable tubular lining within said pipe.
- 3 A composite lining as claimed in claim 1 or 2 wherein, the containment layer is provided concentrically within the structural layer the containment layer being bonded to at least a portion of an internal surface of the structural layer.
- 4 A composite lining as claimed in claim 1 or 2 wherein, the containment layer is provided concentrically outside the structural layer.
- 5 A composite layer as claimed in any preceding claim wherein, the structural layer comprises a strip helically wound to form a plurality of turns, each turn being in substantial helical contact with the previous turn thereby forming a substantially continuous tubular lining within said pipe.
- 6 A composite lining as claimed in any preceding claim wherein the structural layer is a first structural layer, and the composite lining is provided with a further structural layer, the further layer comprising at least one strip of lining material arranged to form a substantially continuous lining within said pipe.

- 7 A composite lining as claimed in claim 6 the further structural layer comprises a strip helically wound to form a plurality of turns, each turn being in substantial helical contact with the previous turn thereby forming a substantially continuous tubular lining within said pipe.
- 8 A composite lining as claimed in claim 6 or 7 wherein the first structural layer is provided concentrically within the further structural layer.
- 9 A composite lining as claimed in claim 6, 7, or 8 wherein:
- the first structural layer comprises a strip helically wound in a first helical direction to form a substantially continuous tubular lining within said pipe; and
- the further structural layer comprises a strip helically wound in a second helical direction to form a substantially continuous tubular lining within said pipe;
- and wherein, the first and second helical directions are opposite.
- 10 A composite lining as claimed in any preceding claim wherein the containment layer is a first containment layer, and the composite lining is provided with a further containment layer, the further containment layer comprising at least one section of lining material arranged to form a substantially impermeable tubular lining within said pipe.
- 11 A composite lining as claimed in claim 10 wherein the or at least one structural layer is provided between the first and further containment layers.
- 12 A composite lining as claimed in any preceding claim comprising at least three containment layers and at least two structural layers, the containment layers being separated from one another by a corresponding structural layer.
- 13 A method of lining a pipe comprising:

- lining said pipe with a structural layer for providing structural integrity; and
- lining said pipe with a containment layer for providing fluid impermeability;
- wherein, lining said pipe with a structural layer comprises arranging said structural layer to form a substantially continuous lining within said pipe.
- 14 A method of lining a pipe as claimed in claim 13 wherein lining said pipe with said containment layer comprises arranging at least one section of lining material to form a tubular lining and seaming said tubular lining to render it substantially impermeable.
- 15 A method of lining a pipe as claimed in claim 13 or 14 wherein the containment layer is provided concentrically within the structural layer the containment layer being bonded to at least a portion of an internal surface of the structural layer.
- 16 A method of lining a pipe as claimed in claim 13 or 14 wherein the containment layer is provided concentrically outside the structural layer.
- 17 A method of lining a pipe as claimed in any of claims 13 to 15 wherein, lining said pipe with a structural layer comprises helically winding a strip to form a plurality of turns, each turn being in substantial helical contact with the previous turn thereby forming a substantially continuous tubular structural layer within said pipe.
- 18 A method of lining a pipe as claimed in any of claims 13 to 17 wherein the structural layer is a first structural layer, and the method further comprises lining the pipe with a further structural layer, the further layer comprising at least one strip of lining material arranged to form a substantially continuous lining within said pipe.
- 19 A method of lining a pipe as claimed in claim 18 lining said pipe with said further structural layer comprises helically winding a further strip to form a plurality of turns, each turn being in substantial helical contact with the previous turn thereby forming a substantially continuous tubular structural layer within said pipe.

- 20 A method of lining a pipe as claimed in claim 18 or 19 wherein the first structural layer is provided concentrically within the further structural layer.
- 21 A method of lining a pipe as claimed in any of claims 18 to 20 wherein:
- lining the pipe with a first structural layer comprises helically winding a strip in a first helical direction to form a substantially continuous tubular lining within said pipe; and
- and lining the pipe with the further structural layer comprises helically winding further strip in a second helical direction to form a substantially continuous tubular lining within said pipe;
- wherein, the first and second helical directions are opposite.
- 22 A method of lining a pipe as claimed in any of claims 13 to 21 wherein the containment layer is a first containment layer, and the method further comprises lining the pipe with a further containment layer by arranging at least one further section of lining material to form a tubular lining and seaming said tubular lining to render it substantially impermeable.
- 23 A method of lining a pipe as claimed in claim 22 wherein the or at least one structural layer is provided between the first and further containment layers.
- 24 A method of lining a pipe as claimed in any of claims 13 to 23 wherein the method further comprises lining the pipe with at least three containment layers and at least two structural layers, the containment layers being separated from one another by a corresponding structural layer.
- 25 A test structure for testing the fluid impermeability of a tubular containment layer of a composite lining according to any of claims 2 to 11 comprising:

a seam along a longitudinal length of said containment layer, the seam comprising at least two substantially parallel seamed regions;

and a conduit formed between said seamed regions.

- 26 A method for testing the fluid impermeability of a tubular containment layer of a composite lining according to any of claims 2 to 11 comprising:

providing said containment layer with a seam along a longitudinal length of said containment layer, the seam comprising at least two substantially parallel seamed regions; and a conduit formed between said seamed regions;

pressurising said conduit with a fluid;

determining if said fluid is leaking from either of said parallel seamed regions.

- 27 An apparatus for providing a loosely twisted helical strip of lining material for lining a pipe, the apparatus comprising:

a base portion; and

coil support means rotatably mounted on said base portion for supporting a coil of said lining material and for allowing a strip of said lining material to be dispensed from said coil;

the coil support means being rotatable in a controlled manner relative to said base portion for inducing helical twists in said strip of lining material.

- 28 An apparatus as claimed in claim 27, wherein:

said coil support means is configured to dispense said strip from a centremost end of said coil, thereby allowing a strip with a naturally induced helical twist to be dispensed;

said naturally induced twist being additional to any rotation induced twist.

- 29 An apparatus as claimed in claim 27 or 28, wherein:

said coil support means is provided with a strip dispensing portion comprising an aperture for dispensing said strip through;

said strip dispensing platform being rotatable independent of said coil support means relative to said base portion.

- 30 An apparatus as claimed in claim 27, 28 or 29, wherein:

said coil support means is rotatably mounted on said base portion for rotation about the axial centre of said coil.

- 31 An apparatus as claimed in any of claims claim 27 to 30, wherein:

said coil support means is rotatably mounted on said base portion for rotation about an axis substantially perpendicular to the axial centre of said coil.

- 32 An apparatus for helically lining a pipe with a strip of lining material, the apparatus comprising:

a winding rig comprising helical winding means;

said helical winding means being configured for helically winding said strip into a helically wound lining layer for lining an inside surface either of said pipe or of a previously laid lining layer.

- 33 An apparatus for helically lining a pipe as claimed in claim 32 wherein,

said winding means is configured for helically winding said strip directly onto said inside surface;

and said winding rig is configured for longitudinal travel along said pipe as each turn of said helically wound lining layer is formed on said inside surface.

- 34 An apparatus for helically lining a pipe as claimed in claim 32 or 33 wherein,

said winding means is configured for helically winding said strip directly onto said inside surface;

and said winding rig is configured for free rotation about a longitudinal axis of said pipe as each turn of said helically wound lining layer is formed on said inside surface.

- 35 An apparatus for helically lining a pipe as claimed in claims 32 wherein,

said winding means is configured for winding said lining strip into a helically wound portion layer, and for driving said helically wound tubular portion along said pipe thereby to form said helically wound lining layer on said inside surface.

- 36 An apparatus for helically lining a pipe as claimed in claims 35 wherein, said winding means comprises:

a cylinder rotatably mountable on an end of said pipe for winding said lining strip onto an internal surface thereof thereby to form said helically wound portion;

and a helical guide mounted on said internal cylinder surface for driving said helically wound portion along said pipe thereby to form said helically wound lining layer on said inside surface either of said pipe or of a previously laid lining layer.

- 37 An apparatus for lining a pipe with a tubular containment layer comprising:

a formation portion comprising at least one rounding die for forming a sheet of lining material into a substantially cylindrical tubular structure.

38 An apparatus as claimed in claim 37 wherein the formation portion further comprises:

at least one formation die for forming a sheet of lining material into a flattened tubular structure;

the rounding die being located for forming said flattened tubular structure into said substantially cylindrical tubular structure.

39 A welding apparatus for seam welding a containment layer in a pipe the apparatus comprising:

a mobile unit configured for longitudinal travel down said pipe;

said mobile unit comprising at least one seam welding head for welding a seam of said containment layer.

40 A welding apparatus as claimed in claim 39 wherein the mobile unit further comprises at least one further welding head for welding said containment layer to an underlying structural layer.

41 A welding apparatus as claimed in claim 39 or 40 wherein, the or each welding head comprises an infra-red source for inducing heat thereby to cause said welding.

42 A welding apparatus as claimed in claim 39 or 40 wherein, the or each welding head comprises an ultrasound source for inducing heat thereby to cause said welding.

43 A welding apparatus as claimed in any preceding claim wherein, the or each seam welding head includes a pressurising fan for applying air pressure to said seam during welding.



- 44 A welding apparatus as claimed in any preceding claim wherein the or each seam welding head comprises a shield portion for preventing a longitudinal portion of said seam from being welded, thereby to form a fluid impermeable conduit.